

Play and Learn: Potentials of Game-Based Learning

by

Maja Pivec

Play and Learn: Potentials of Game-Based Learning

Presented by

Dr Maja Pivec

MODSIM, September 12th 2007

FH JOANNEUM
Information Design

Game-Based Learning

- Games and learning - how does this work?
- Game about designing a game & results
- Transferability - GBL in Medicine
- Games for Treatment

Games Characteristics

Game elements

- Fantasy – Imaginary or fantasy context, themes, or characters.
- Rules/Goals – Clear rules, goals, and feedback on progress towards the goals.
- Sensory Stimuli – Dramatic or novel visual and auditory stimuli.
- Challenge – Optimal level of activity and uncertain goal attainment.
- Mystery – Optimal level of informational complexity.
- Control – Active learner control.

Malone, T. W. (1981). What makes computer games fun? *Byte*, 6(12), 258-277.

Games - Motivation and Learning

Games enhance motivation and
increase students interest in subject matter

*... yet the extent to which this translates into
more effective learning is less clear*

[Druckman (1995)]

Games - Theory of "Flow"

- Tasks that can be completed.
- The ability to concentrate on the task.
- Where concentration is possible because the task has clearly identified goals.
- Where concentration is possible because the task provides immediate feedback.
- The ability to exercise a sense of control over one's actions.
- An immersion that removes awareness of the frustrations of everyday life.
- The concern for one's self disappears but emerges stronger afterwards.
- The sense of the duration of time is altered.

[Csikszentmihalyi, M. (1990)]

Games - Immersion

Causes a
“persistant re-engagement”
of the Player.

Kearney, P., & Pivec, M. (2007). *Immersed and how? That is the question.*
Paper presented at the Games in Action Conference, Gothenburg, Sweden.

Games - Identifying Immersion

Eye Tracking to Identify Player Immersion



Games - Eye Tracking

Quake II

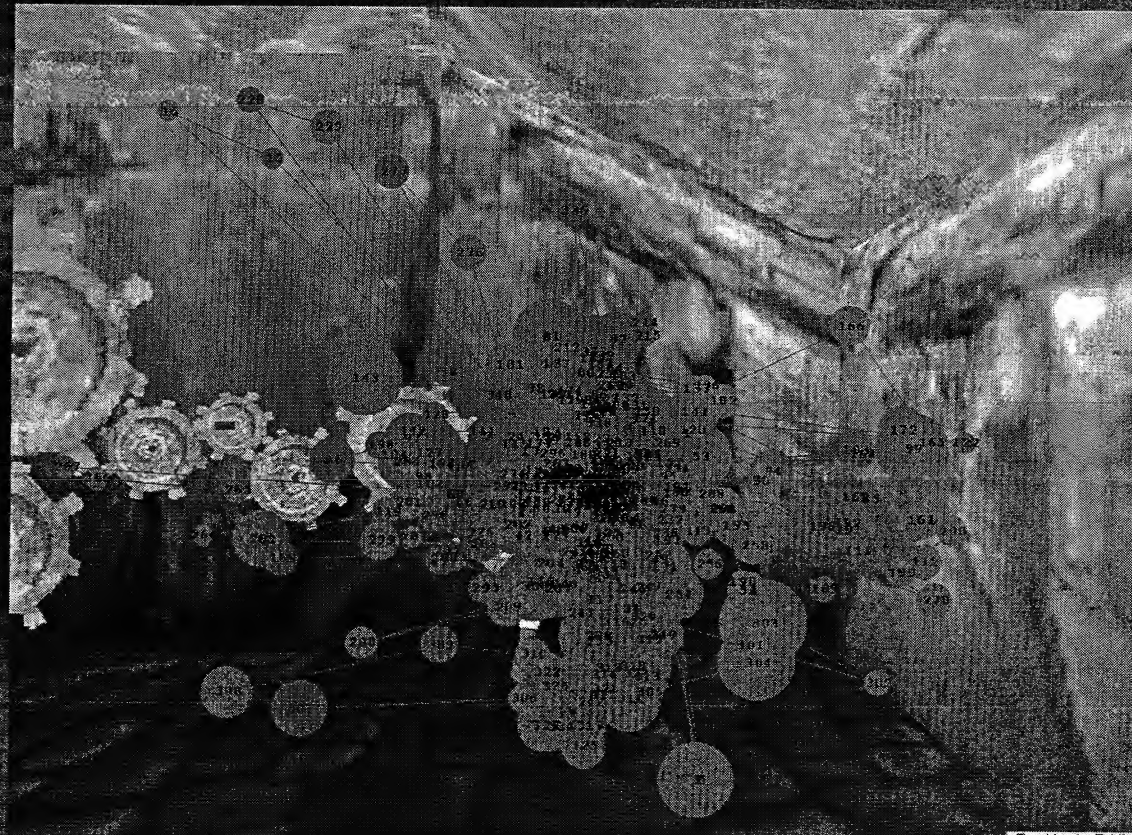


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Games - Eye Tracking

Tomb Raider



Tracking by Tobii

STUDY: sims2. STIMULUS: game. RECORDING: tomraider. FRAME: StaticBitmap.bmp.
TIME SEGMENT: Only include fixations inside interval [0,197819] ms.

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Games - Eye Tracking

NeverWinter Nights



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How to design effective learning opportunities?

- learners are encouraged to combine knowledge from different areas to choose a solution or to make a decision at a certain point,
- learners can test how the outcome of the game changes based on their decisions and actions,
- learners are encouraged to contact other team members and discuss and negotiate subsequent steps,
- thus improving their social skills.

Game-Based Learning

Learning is the acquisition of knowledge or skills through experience, practice, or study.

Learning outcomes are the knowledge, skills, and abilities that the student will possess following the learning experience.

Player's Learning Outcomes

- Skill-based learning outcomes
performance of technical or motor skills
- Cognitive learning outcomes
declarative knowledge
procedural knowledge
strategic knowledge
- Affective learning outcomes
beliefs or attitudes regarding an object or activity

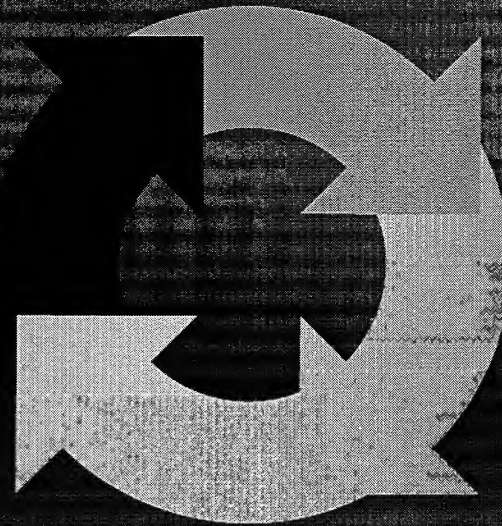
In-Game Cycle

Concrete Experience

Active
Experimentation

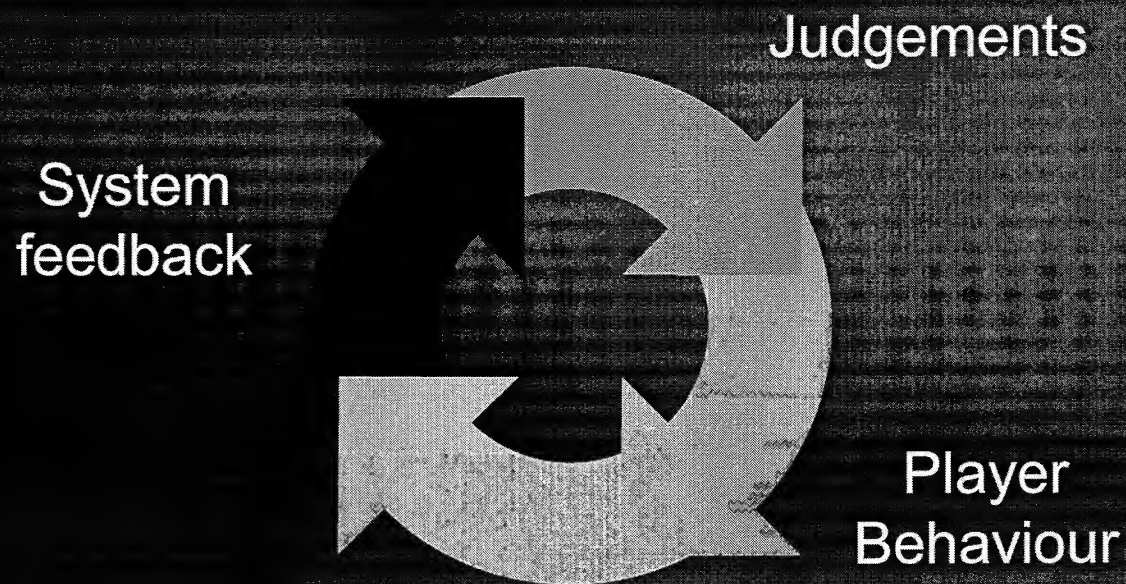
Reflective
Observation

Abstract Conceptualisation



Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development*. Englewood Cliffs, NJ: Prentice-Hall.

In-Game Cycle



Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice. model. *Simulation & Gaming*, 33(4), 441-467

Player's Reflection

- **Reflection-in-Action**

If play is broken up with reflection, learning is reduced. If reflection is dispersed within the game, learning is increased.

Player's Abilities

- The Player must be able to enter the game at the appropriate level
- The cognitive challenge must be appropriate for the player's ability
- As the player's skill level is incremented, the challenge must increase

Player's Abilities

*"Persistent Re-engagement comes from
Player Immersion"*

*"Player Immersion is the result of
Scaffolded Challenge"*

So how does this occur....

Kearney, P., & Pivec, M. (2007). *Immersed and how? That is the question.*
Paper presented at the Games in Action Conference, Gothenburg, Sweden.

Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural,
Strategic Knowledge)

Player
Abilities

Instructional
Design

Game
Characteristics

Persistent Re-Engagement
Zones of Proximal Development

Level 1

2 3 4

Level Completed
(Abilities incremented)

Level 99

Behaviour

Judgements

System feedback

Debriefing
Reflection-on-Action

Learning
Outcomes

Social Environment
(Affective Learning)

System
feedback

Behaviour

Judgements

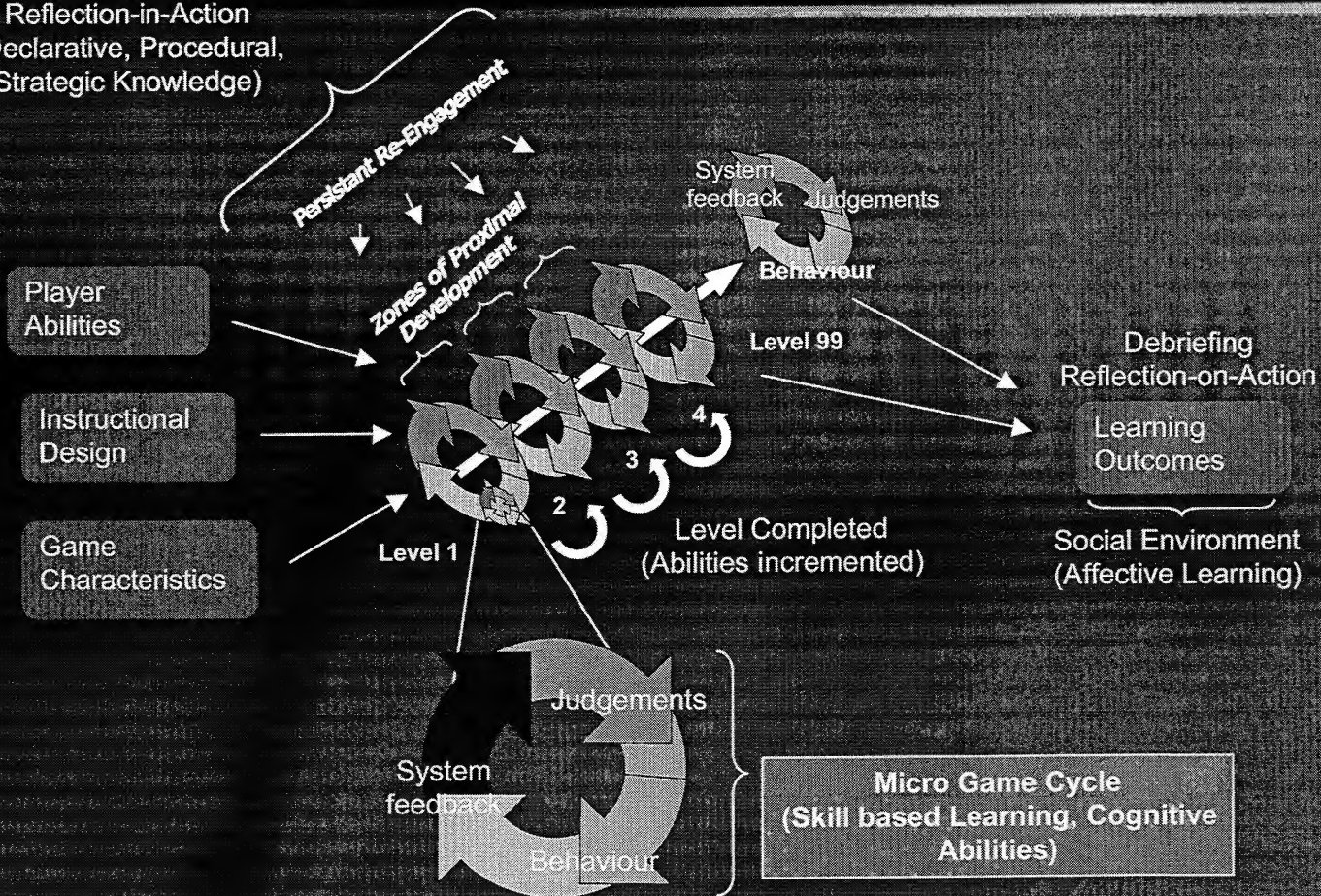
Micro Game Cycle
(Skill based Learning, Cognitive
Abilities)

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Model of Game-Based Learning

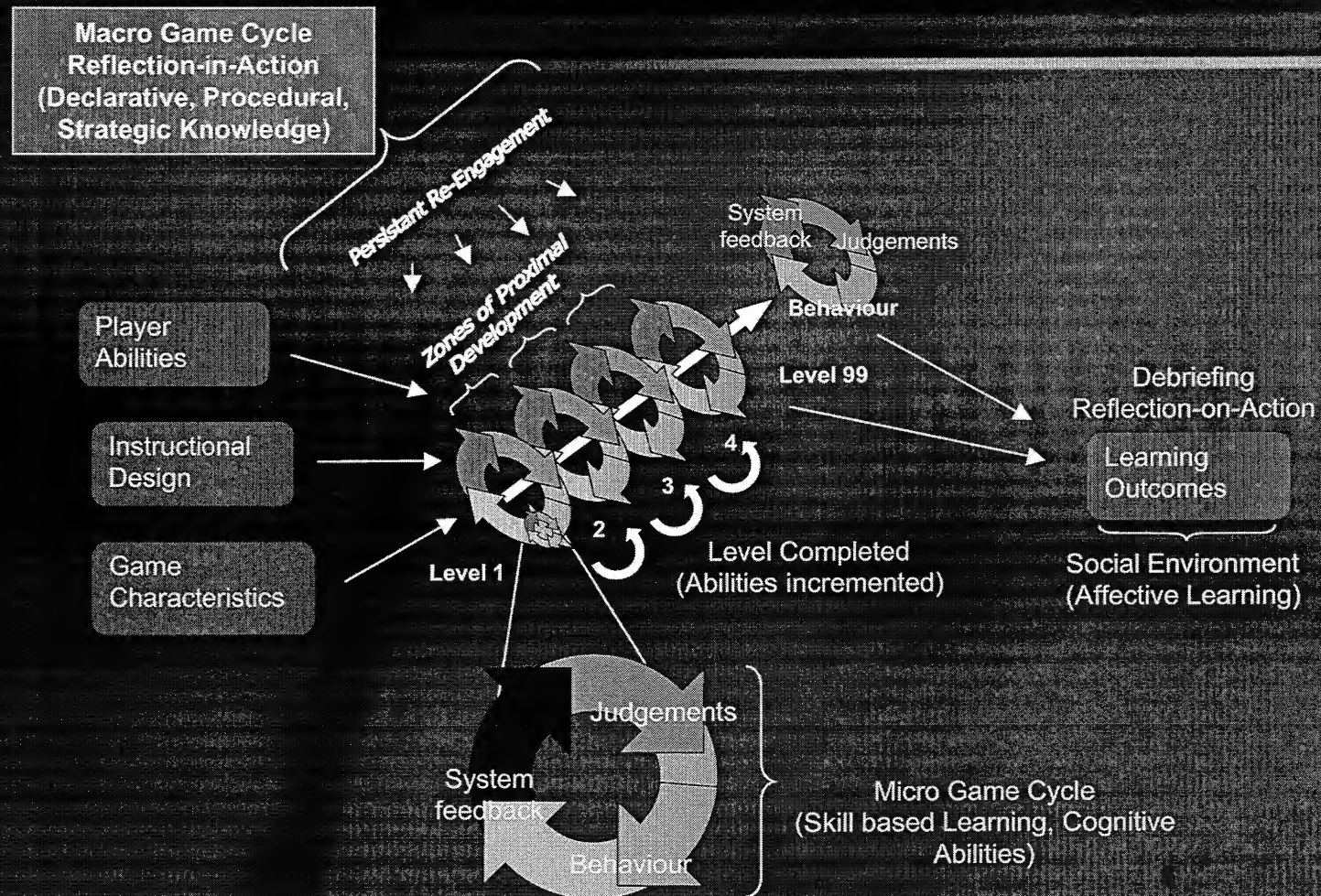
Macro Game Cycle
Reflection-in-Action
(Declarative, Procedural,
Strategic Knowledge)



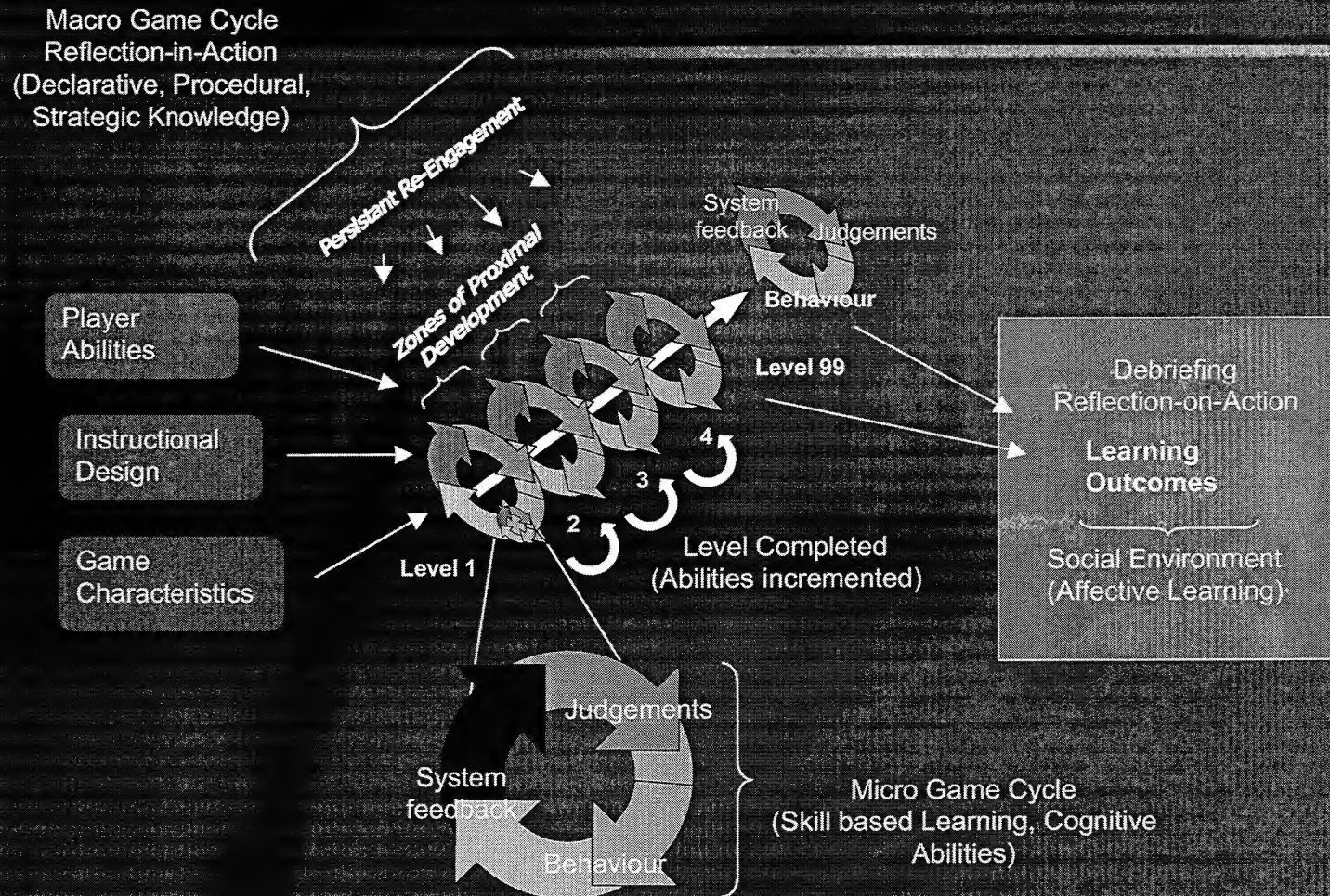
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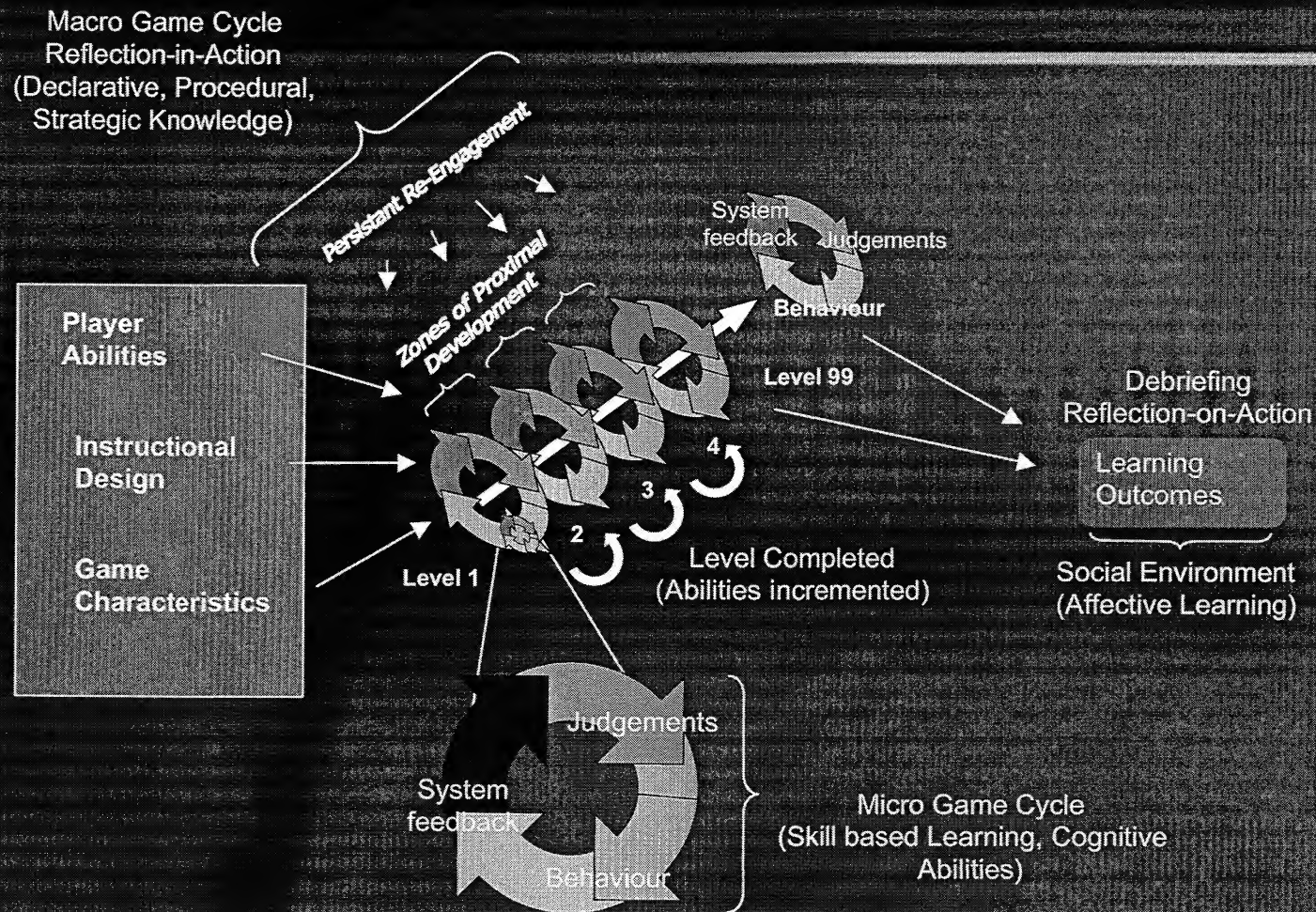
Model of Game-Based Learning



Model of Game-Based Learning



Model of Game-Based Learning

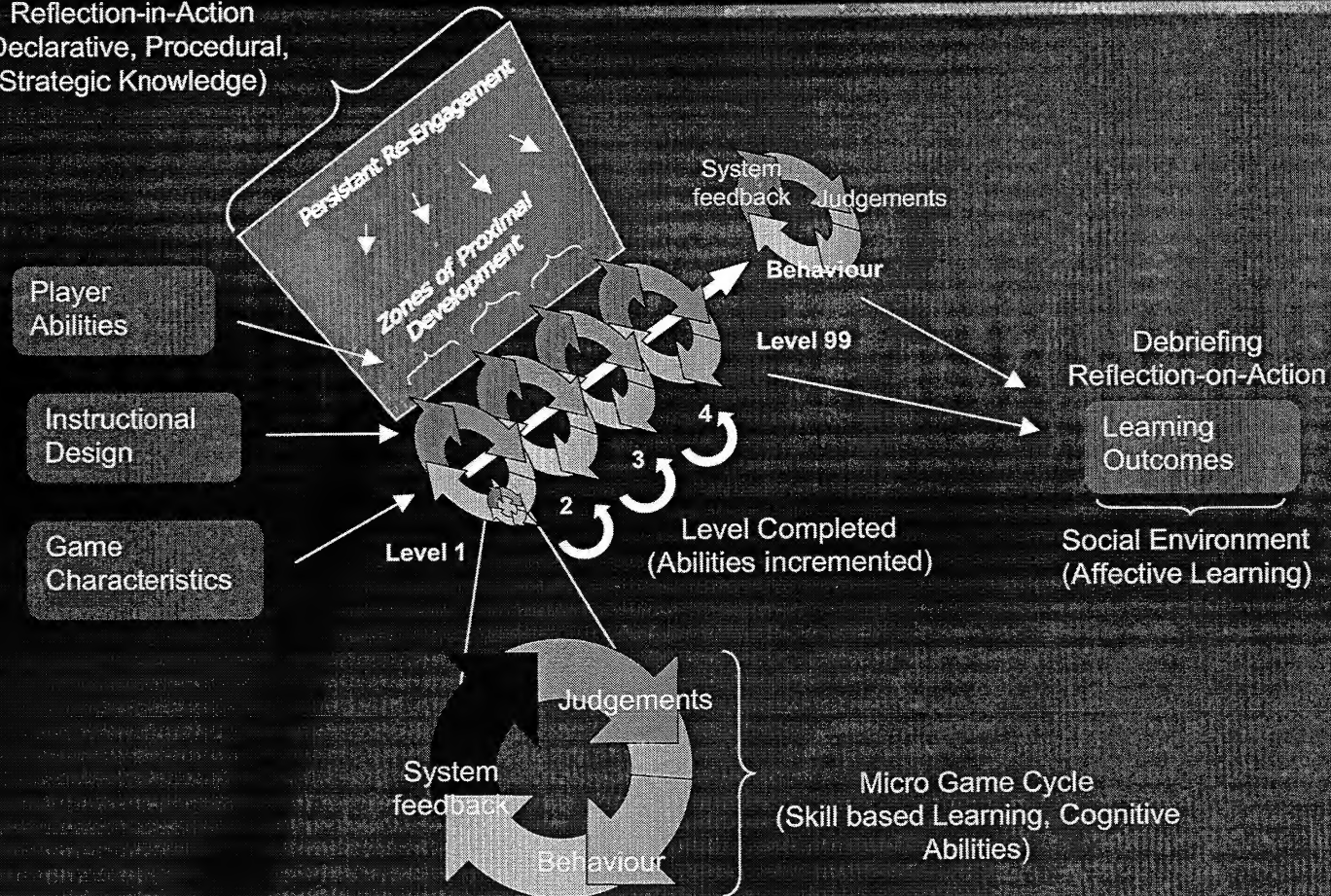


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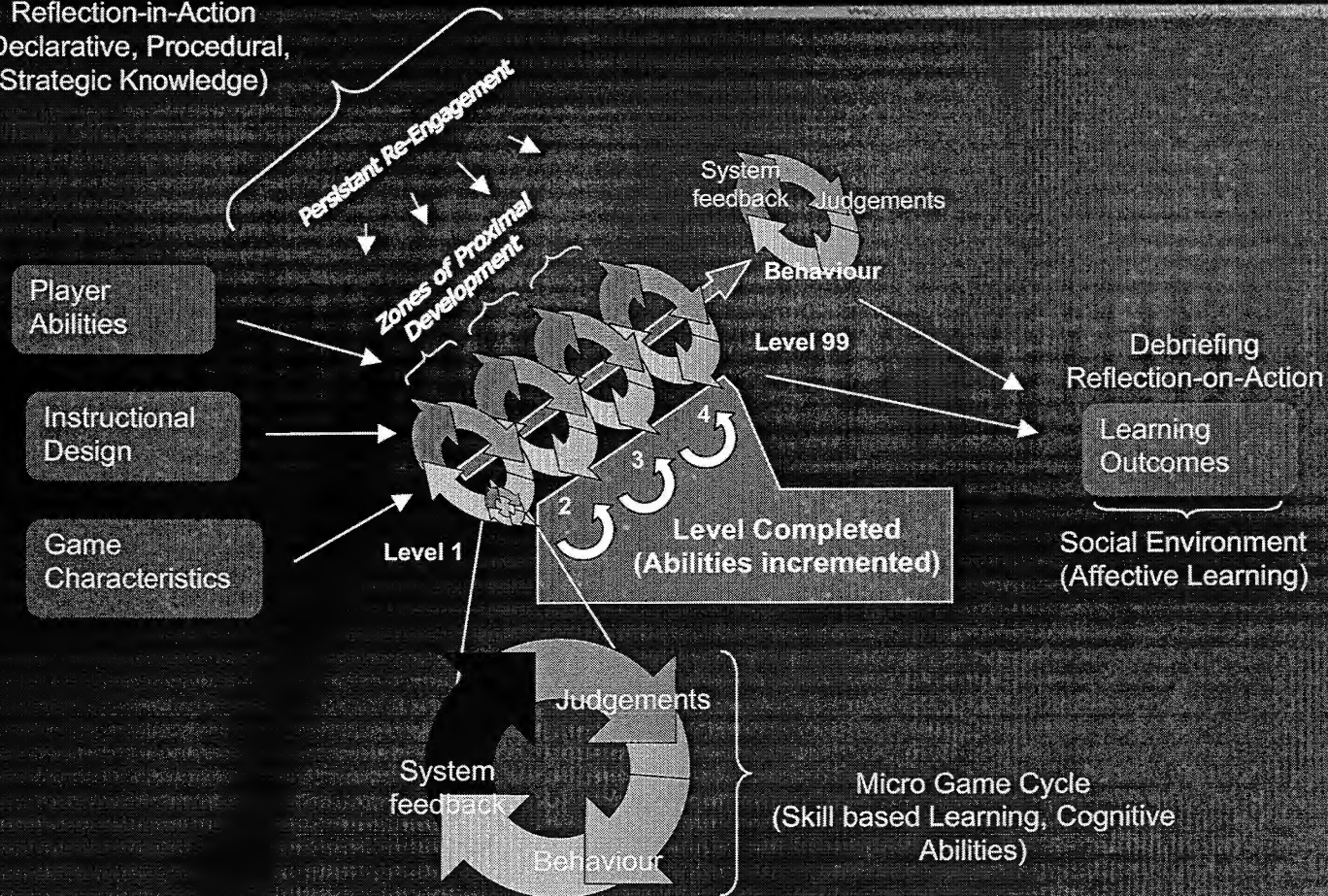
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
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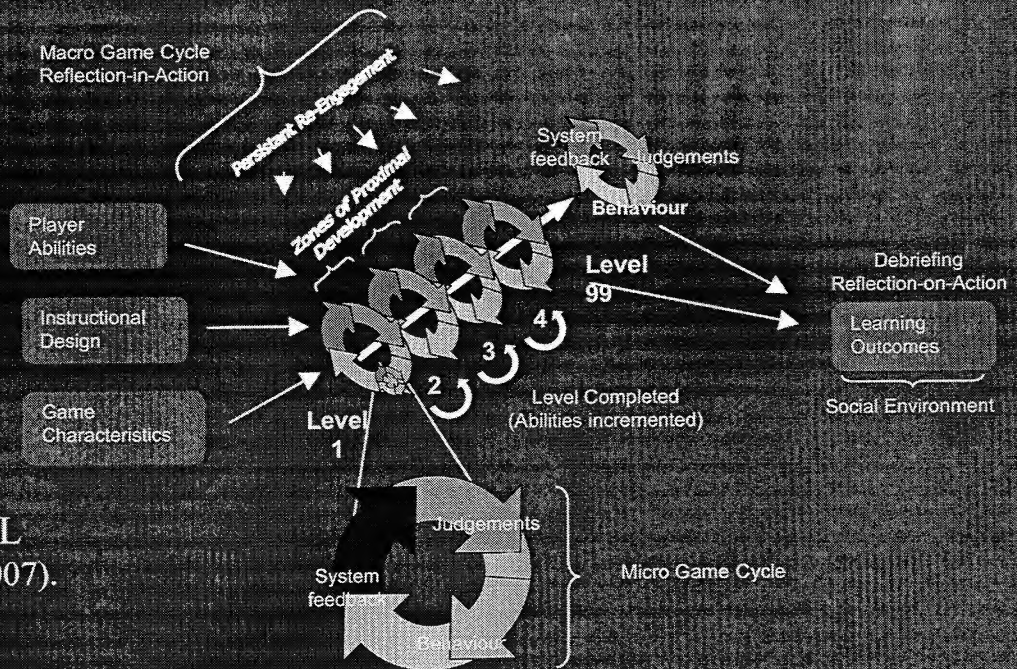
Model of Game-Based Learning

Macro Game Cycle
Reflection-in-Action
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Model of Game-Based Learning

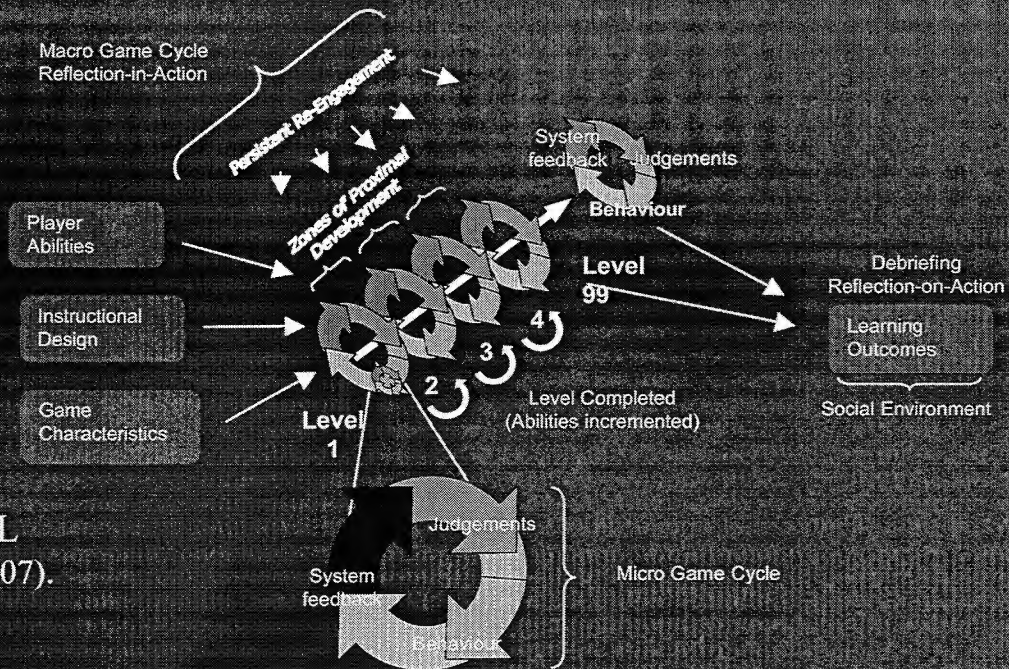
Game-Based Learning occurs in a recursive loop and as such, as skills are acquired or incremented, the player moves to the next level of the game.



Recurring loops of GBL
Kearney, P., & Pivec, M. (2007).

GBL - Learning Outcomes

Game-Based Learning is the “vehicle” that fosters the acquisition of learning outcomes.



Recurring loops of GBL
Kearney, P., & Pivec, M. (2007).

GBL - Learning Outcomes

- Learning Objective: *Memory/ Repetition/ Retention*
- Definition: *Factual Knowledge*
- Appropriate Games/ Typology:

Drill and Practice
Quiz games
Puzzle games

GBL - Learning Outcomes

- Appropriate Games/ Typology:

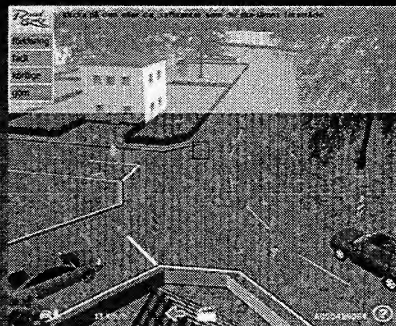
Drill and Practice

Quiz games

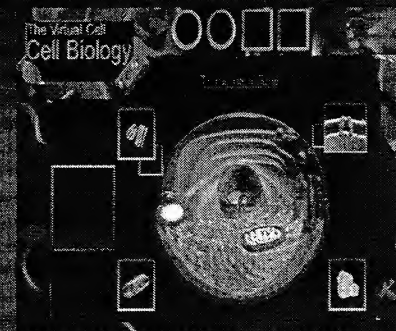
Puzzle games

- Examples:

Roadquiz



Virtual Cell



GBL - Learning Outcomes

- Learning Objective: *Dexterity/ Spread, Precision/ Motoric*
- Definition: *Sensorial/ dexterous knowledge*
- Appropriate Games/ Typology:

Combat/ fighting games
Driving games
Simulation games

GBL - Learning Outcomes

- Appropriate Games/ Typology:

Combat/ fighting games

Driving games

Simulation games

- Examples:

Doom



Flight Simulator



GBL - Learning Outcomes

- **Learning Objective:** *Applying Concepts/ Rules*
- **Definition:** *Translate knowledge into new context: use information, use methods, concepts, theories in new situations*
- **Appropriate Games/ Typology:**
 - Sport games*
 - Action games*
 - Driving games, Drill & Practice*

GBL - Learning Outcomes

- Appropriate Games/ Typology:

Sport games

Action games

Driving games, Drill & Practice

- Examples:

FIFA



Driver



GBL - Learning Outcomes

- Learning Objective: *Decision-making (strategy & problem solving)*
- Definition: *Analysis of knowledge based on problem solving, prediction, drawing conclusions, choice making, reasoned argument*
- Appropriate Games/ Typology:

*Strategic games
Adventure games
Role Play games
Simulation games*

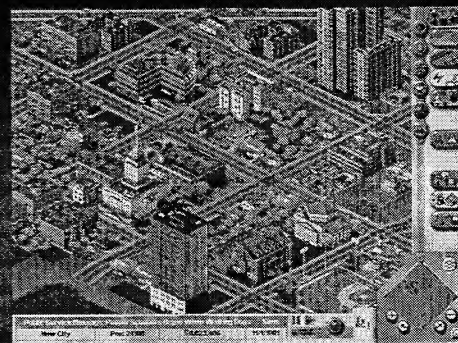
GBL - Learning Outcomes

- Appropriate Games/ Typology:

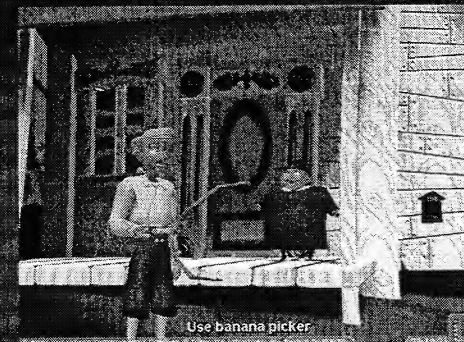
Strategic games
Adventure games
Role Play games
Simulation games

- Examples:

SimCity



Monkey island



GBL - Learning Outcomes

- Learning Objective: *Ability to learn/ Self-assessment*
- Definition: *Evaluation*
- Appropriate Games/ Typology:
 - Role play games*
 - Simulation games*

GBL - Learning Outcomes

- Appropriate Games/ Typology:

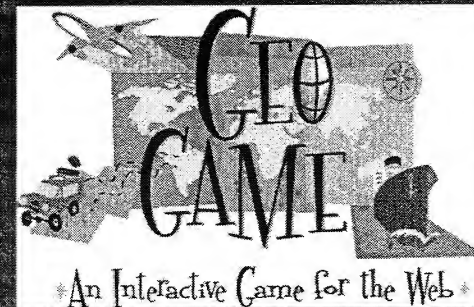
Role play games
Simulation games

- Examples:

The Sims



GeoGame



Educational game design

- Constructivist learning theory
- Exploratory approach to learning
 - interaction, coping with problems, understanding of the whole
 - learners are active participants in knowledge acquisition
 - learners are engaged in restructuring, manipulating, re-inventing, and experimenting with knowledge

Educational game design

Pedagogical goals:

1. to provide an experience with the knowledge-construction process,
2. to provide experiences encouraging appreciation of multiple perspectives,
3. to embed learning in realistic and relevant contexts,
4. to encourage ownership in the learning process,

Educational game design

Pedagogical goals:

5. to embed learning in social experience,
6. to encourage the use of multiple modes of representation,
7. and to encourage self-awareness of the knowledge construction process

Class on GBL

Game about designing a Game

- Team work — one team, one company
 - role within a team – role in a company
 - game producer, game developer, programmer
- Goal — concept of an educational game

Golden Pineapple Award

"Anaphylactic" from Dudary Entertainment



"Keep Me Alive" from Stardust Enterprises



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Anaphylactic

DUDARY
entertainment

ANAPHYLACTIC

The Medical Game



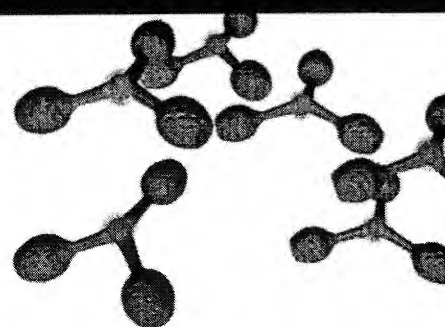
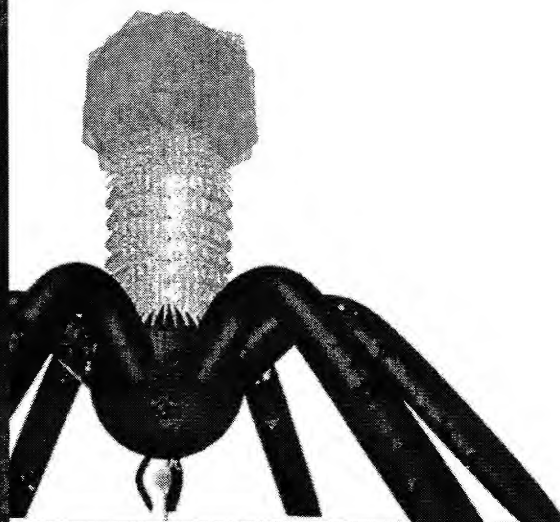
Bayer Thomas, Gumpf Bernhard, Hollinger Michael, Lengauer Patrick
IND04 - Game Based Learning
Paul Kearny | Maja Pivec

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Anaphylactic

.the game

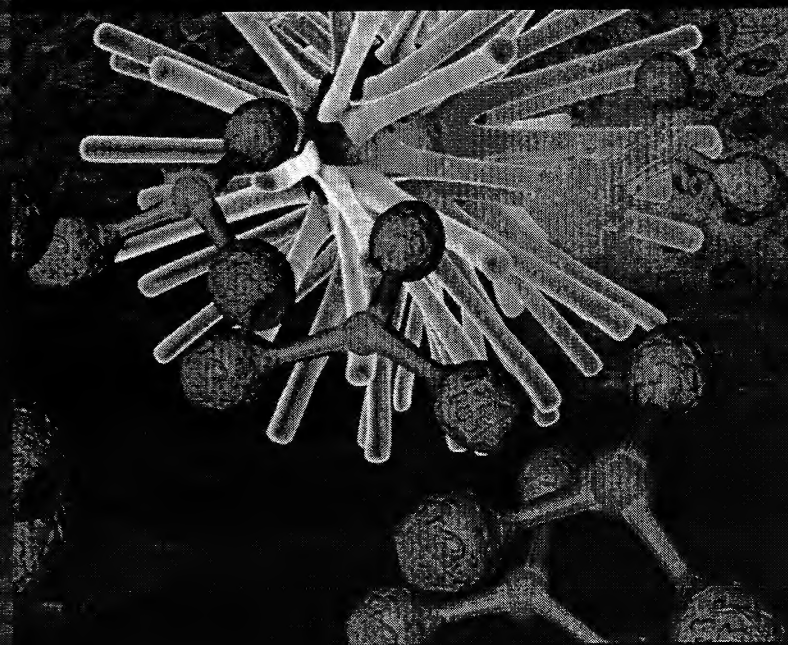


DUDARY
entertainment

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Anaphylactic



.the challenge

DUDARY
entertainment

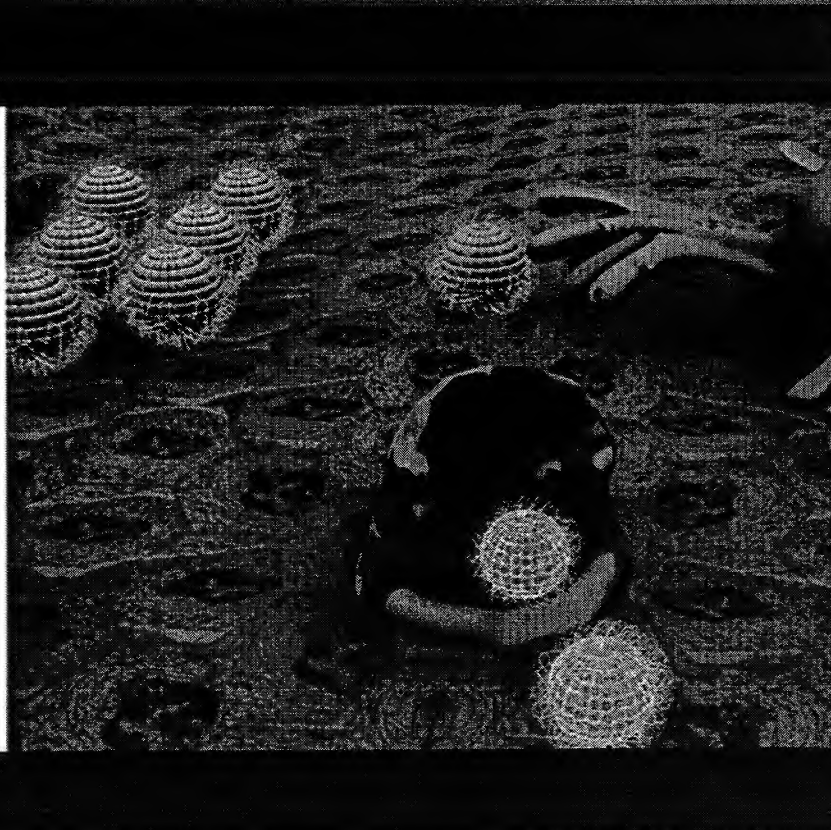
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Anaphylactic

.the progress

 **DUDARY**
entertainment



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Anaphylactic



.the interface

DUDARY
entertainment

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Anaphylactic

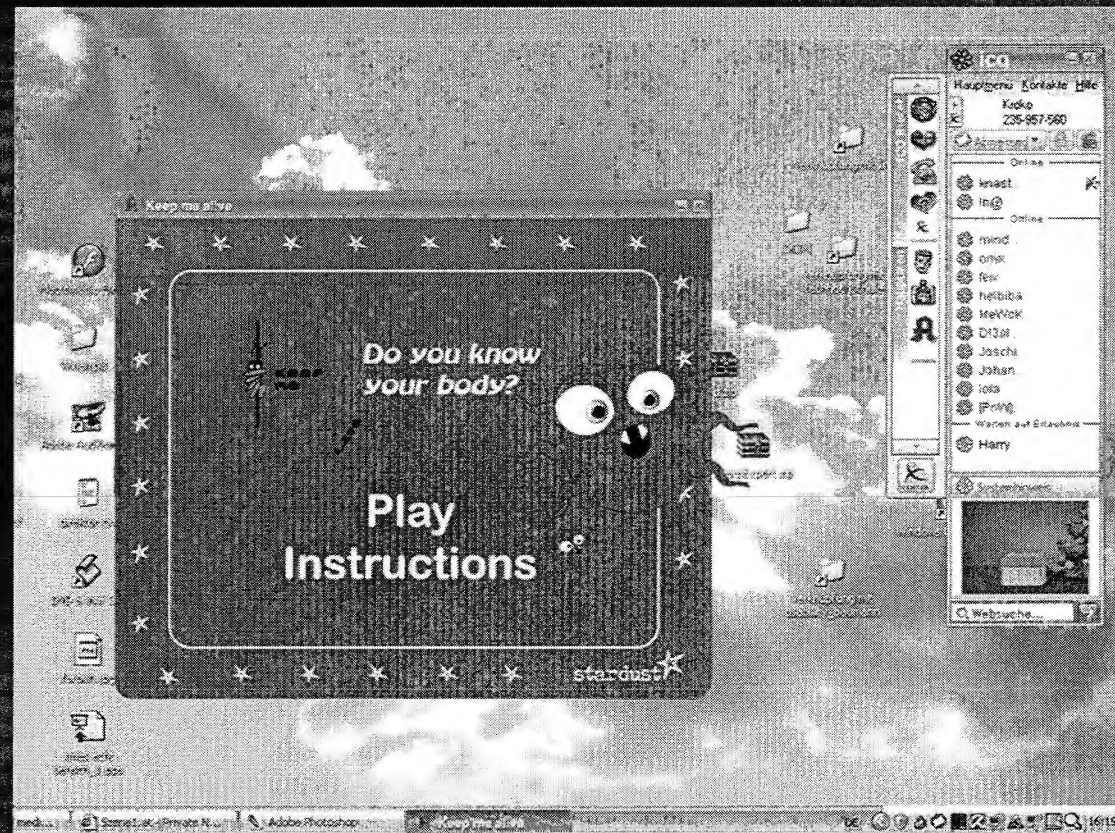
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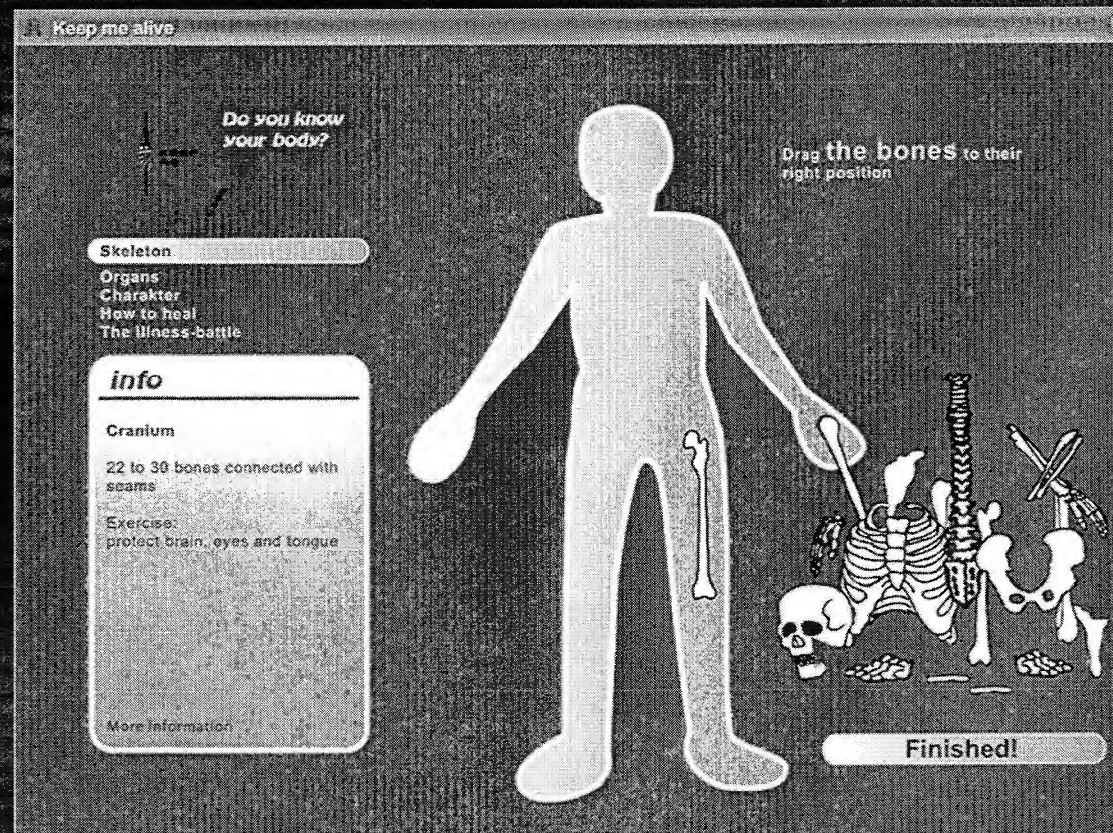
Keep Me Alive



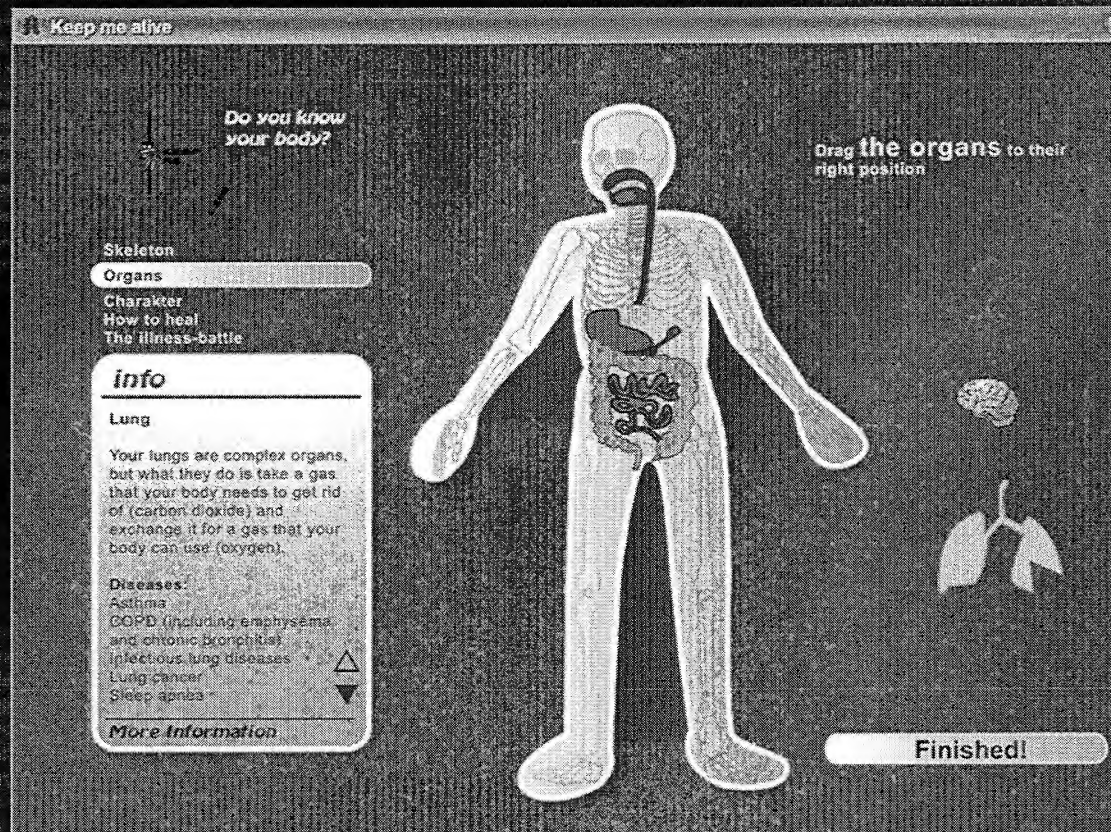
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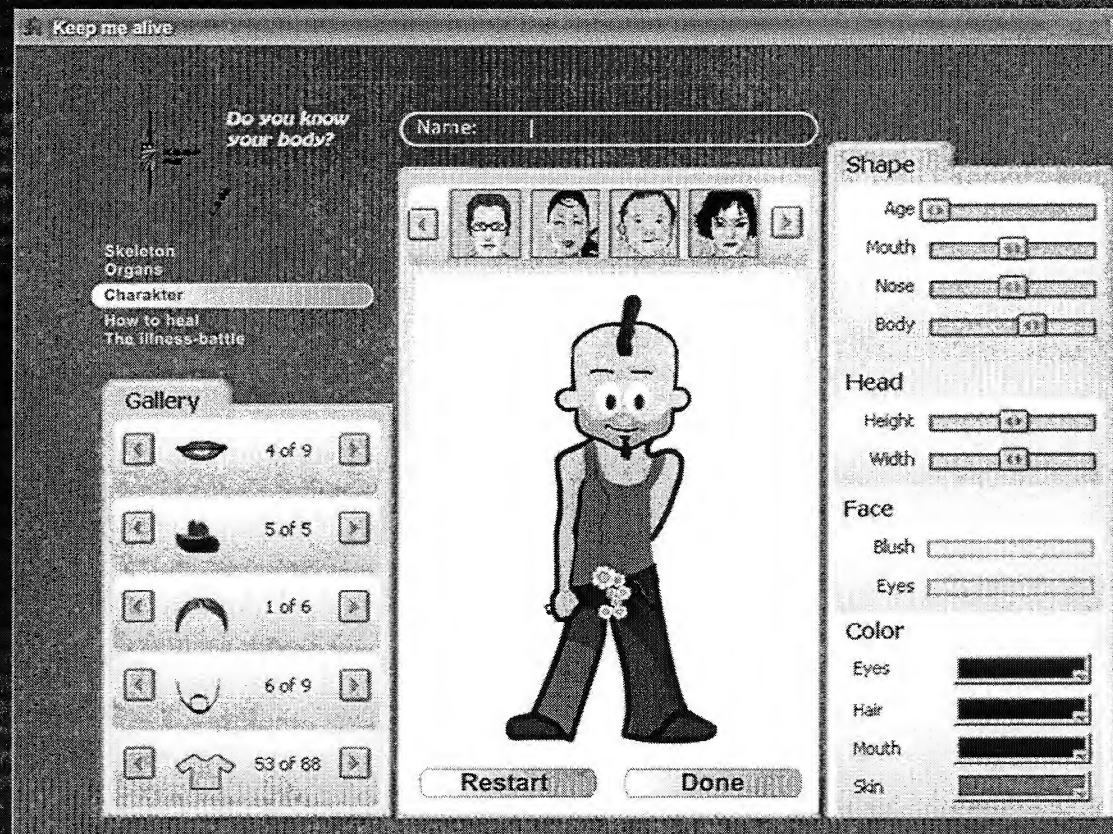
Keep Me Alive



Keep Me Alive



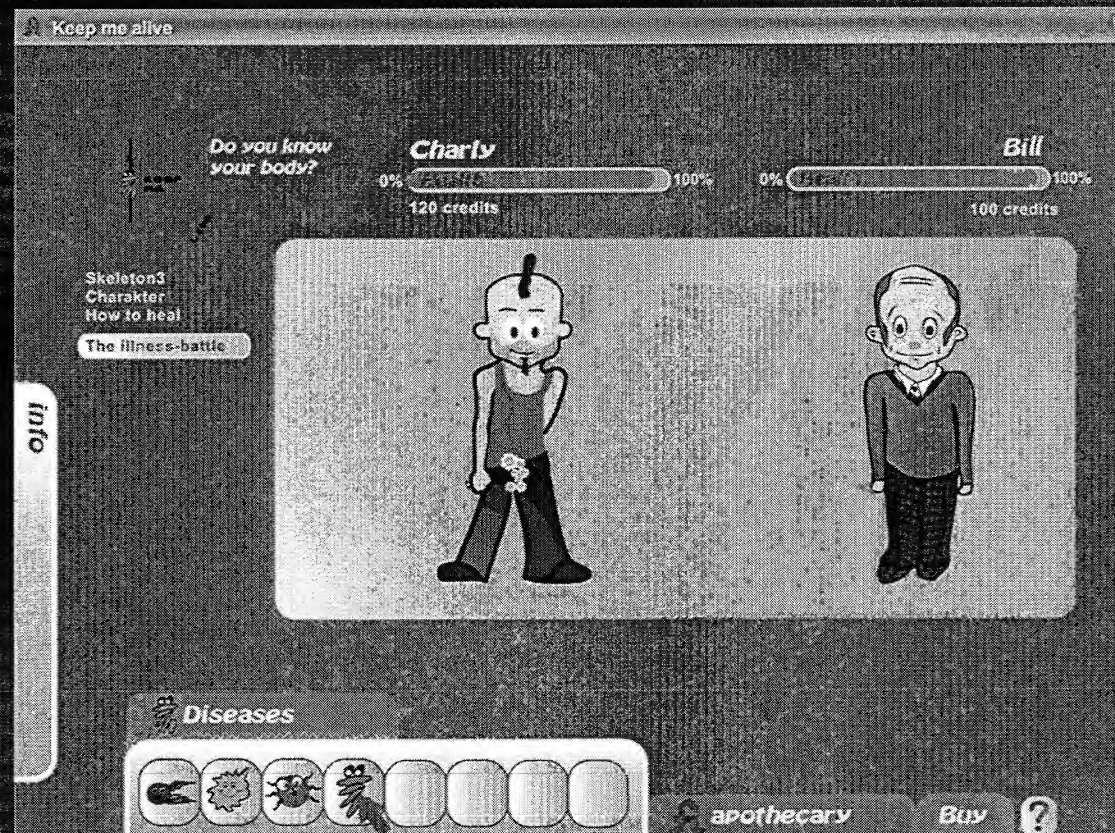
Keep Me Alive



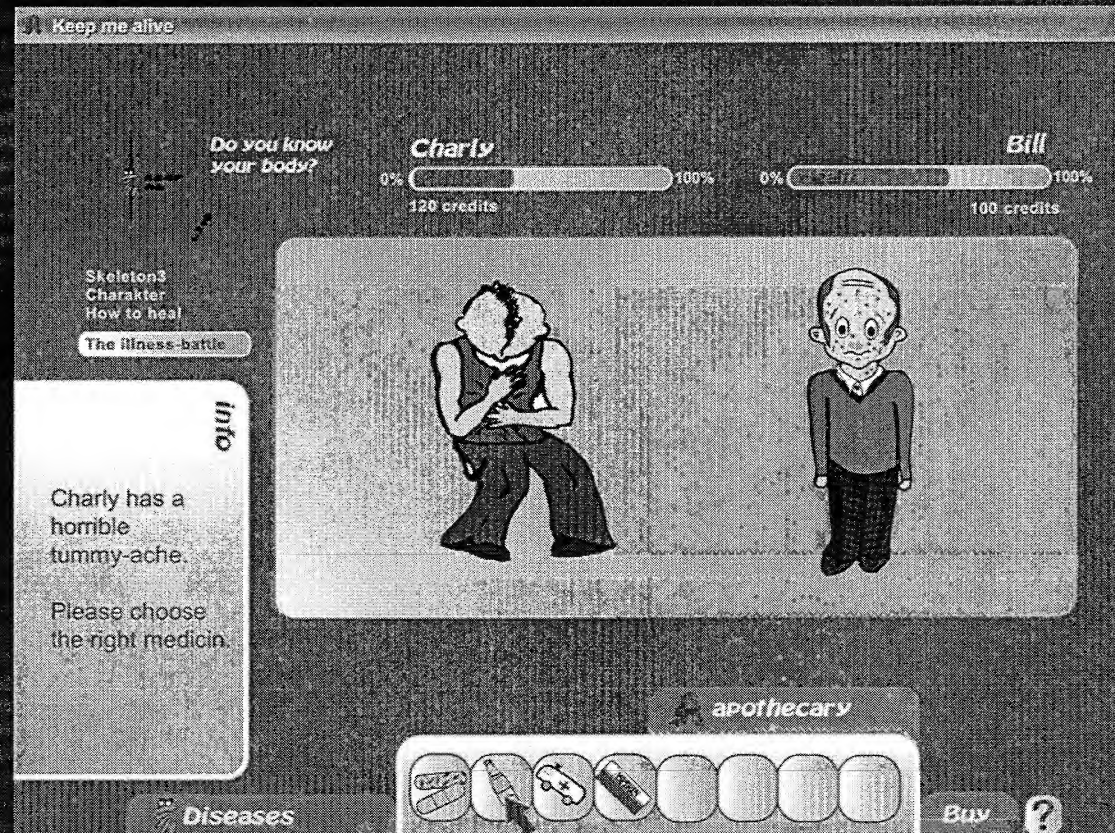
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Keep Me Alive



Keep Me Alive



Potentials of GBL

- Formal and informal learning
- Educational game for interdisciplinary learning
- Context based environment
- Off the shelf game

Contagion

- role-playing adventure game
- fostering interdisciplinary learning
- targeted at children aged 10 – 15
- based on active exploration

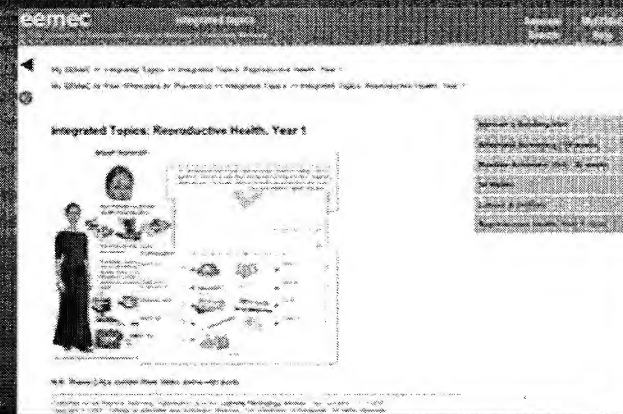


[de Castell, 2006]

Information about diseases, such as Severe Acute Respiratory Syndrome (SARS), West Nile Virus (WNV), Avian Flu, and Acquired Immune Deficiency Syndrome (AIDS)

Career preparation environment, community health officer, physician, or a medical researcher

- curricular topics blurred with narrative elements thus creating a realistic context
- condition gets more complicated as they progress in their studies



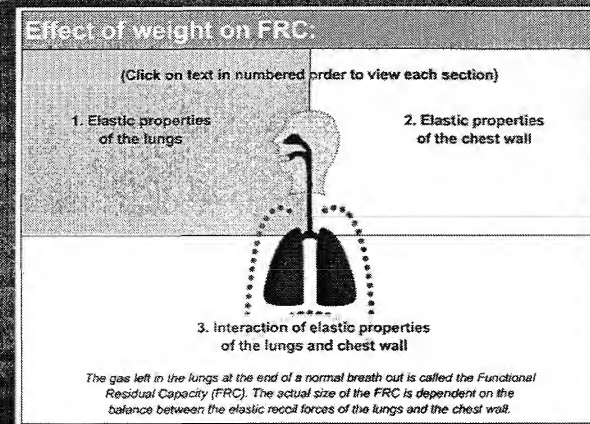
<http://www.eemec.med.ed.ac.uk/visitors/>

Students are role playing “to be a doctor”, until the end of their education when they become doctors

[Begg et al 2006]

Labyrinth

- situation (plus) various choices
- repeated interaction with “what if” reflections
- College of Medicine and Veterinary Medicine’s Learning Technology Section at the University of Edinburgh



<http://www.eemec.med.ed.ac.uk/visitors/>

Role-play focused on decision-making scenarios

[Begg et al 2006]

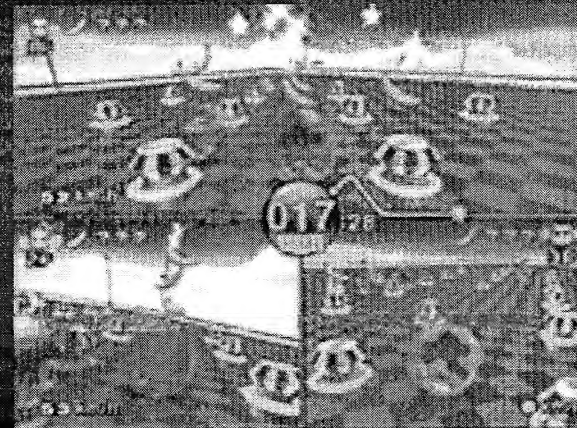
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Top Gun

Video games as teaching tool for improvement of laparoscopic skills

- fewer errors,
- better performance
- faster completion



Super Monkey Ball - Nintendo © 1997-2007

"Video games may help thin the technical interface between surgeons and screen-mediated applications"

[Rosser et al 2007]

Application Cases

e-Inclusion by means of Game-Based Learning

[Pivec *et al.*, 2005]

- Socialization
- Creating experience
- Therapeutic application of game environments

Socialization

- personal development and improvement of self esteem of the learner
- establishing the dialogue and breaking social and cultural boundaries



*„makes me feel like a
real person“*

[Kearney, 2005]

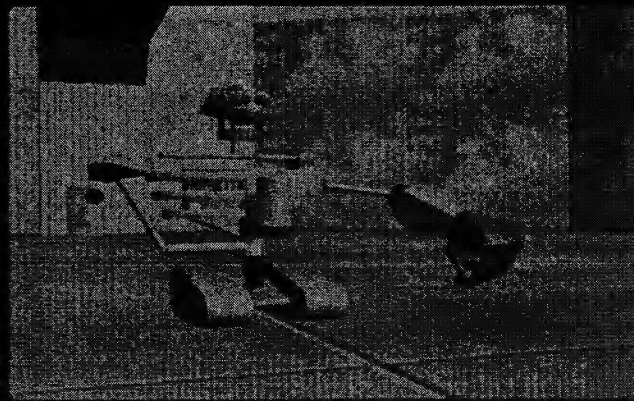
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Creating experience

Terraformers - 3D adventure game for sighted and blind.

- provides a standard graphics mode
- also has a high contrast mode for gamers with low vision
- can be played with no graphics for the blind

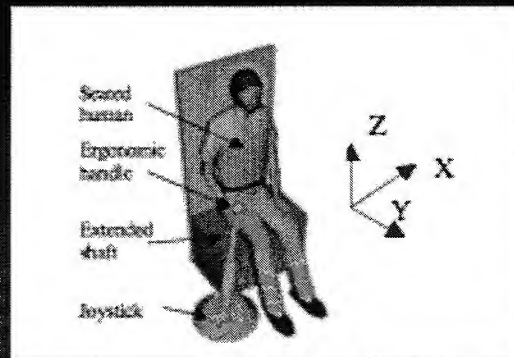


<http://www.terraformers.nu/eng/features.php>

Therapeutic application of game environments

- force feedback joystick for the therapy of cerebral palsy
- 40% in movement precision and movement speed using this technique

[Geerdink *et al.*, 2003]



Therapeutic application of game environments

- VR and Sony's Eye-toy
- Snowboarding, Volleyball, Soccer.

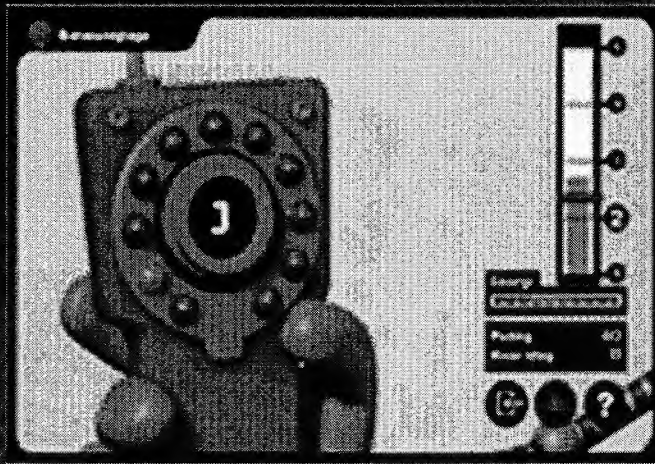


*“perceived physical changes and
increased social acceptance
from peers and family”*

[Miller & Reid, 2003]

Therapeutic application of game environments

- RoboMemo
- improvement of working memory capacity



complementary treatment for people
with Attention Deficit Hyperactivity
Disorder (ADHD)

<http://www.cogmed.com/cogmed/articles/en/2.aspx>

Therapeutic application of game environments

- PI - 3D game for adolescent psychotherapy
- depression, anxiety and social skills problems, and engage more easily with therapists
- play therapy, therapeutic storytelling, interactive narrative systems



Media Lab Europe and
Trinity College Dublin
[Coyle *et al.*, 2005]

Conclusions

The success of any game is dependant on the games ability to maintain immersion by staying within the upper zone of the player's ability.

Conclusions

*Opportunity to get the experiences and to learn in a
“safe virtual world”*



Thank You

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Discussion

Why don't we use games more often in classrooms?

- Low tolerance of the environment for the games
- Perceived as unserious activity
- Fear not to reach learning objectives
- Lack of technical resources
- Quality of games as learning resources

II. Learning Theory Session

How Learning Theory Supports Using Modeling, Simulation, and Game-Based Learning to Teach Science, Technology, Engineering, and Mathematics